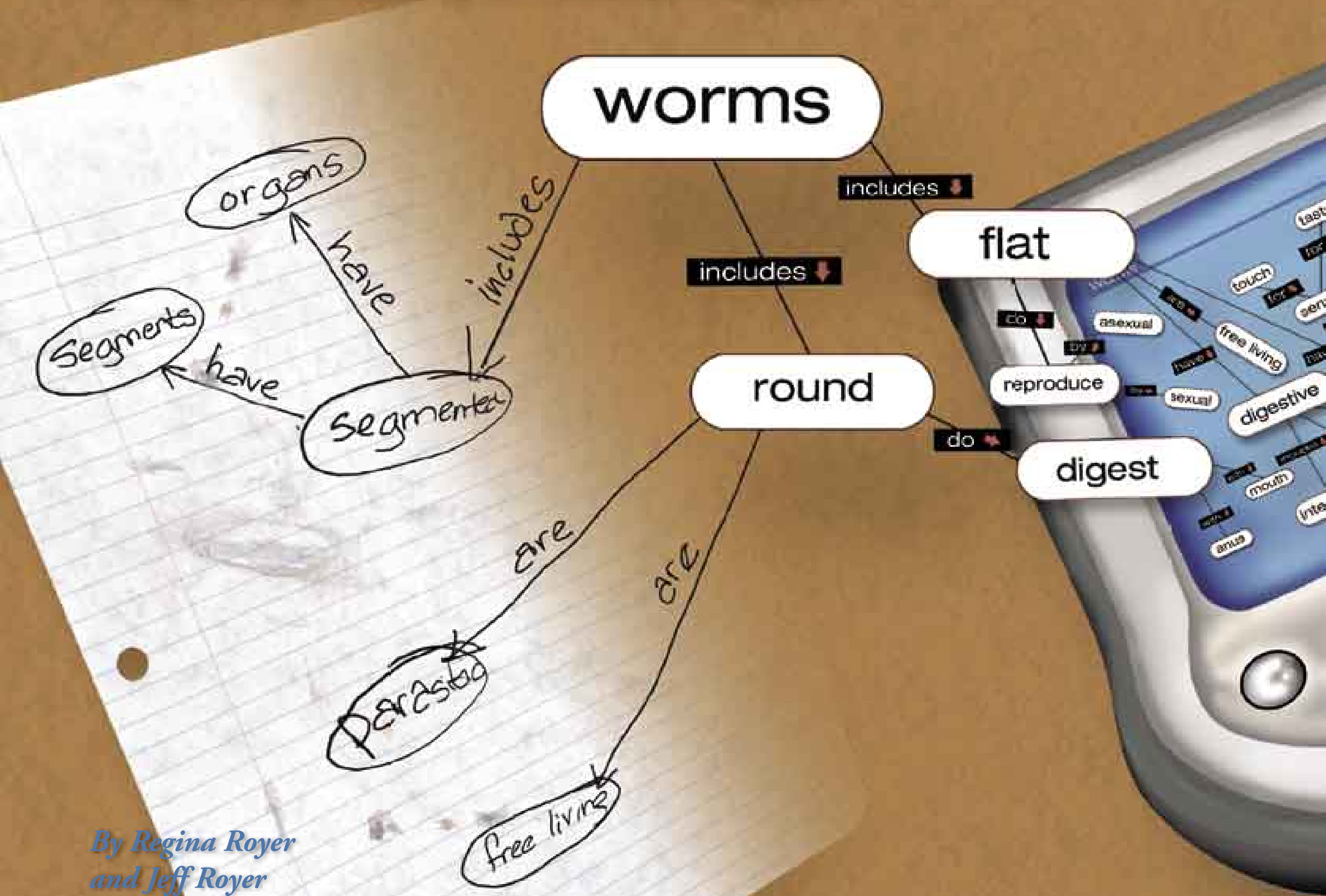
What a Concept!

Using Concept Mapping on Handheld Computers



By Regina Royer and Jeff Royer

Subject: Effects of technology use on student learning and motivation

Audience: Teachers, teacher educators

Grade Level: 5–12 (Ages 10–18)

Technology: Handheld computers, concept mapping software

Standards: *NETS•S* 3; *NETS•T* II (http://www.iste.org/standards/)

One science teacher found that his students developed complex links between ideas after using concept mapping software on desktop and handheld computers.

When designed properly, concept mapping activities can engage students in meaningful learning. In the process of creating concept maps, students relate new information to more general concepts already held, develop fuller understandings of those general concepts, and recognize new relationships between concepts. Students engage in these activities by linking concepts to subconcepts, describing the relationships with propositions, and creating cross links. The more a concept is understood, the more valid subconcepts, links, and cross links there will be in a students' concept map. It follows then if a student creates a more complex map (a map with more subconcepts, links, and crosslinks), then the student better understands the concept. Further, as Joseph D. Novak and D. Bob Gowin discuss in their book *Learning How to Learn,* meaningful learning can occur in the process of identifying relationships, more meaningful learning can occur if a student has tools that support the development of more complex maps. (See Designing Concept Mapping for Meaningful Learning on p. 14 for more on design.) How can technology support concept mapping?

Because of the ease of manipulation, dynamic linking, revision, and integration of graphics, many educators are using desktop computer software such as Inspiration to support students' concept mapping. However, with one computer still the norm in many classrooms, using these tools on a regular basis becomes impractical.

In spring 2003, we investigated the use of handheld computers to provide a cheaper alternative to desktop computing. But the questions became:

1. Would concept maps with handheld computers be as complex as those created with desktop computers?
2. Would students be motivated to use the handheld computers?
3. Would the teacher react favorably to handheld use?

The Lessons

Two ninth-grade biology classes taught by co-author Jeff created concept maps. They began the year creating concept maps on paper and later, after learning to use Inspiration, one class began creating concept maps using Inspiration on desktop computers while the other continued to use paper. To provide computer access for each student, the class using Inspiration moved to a computer lab in the media center to complete each assignment. In the spring, however, Jeff was awarded a grant of 30 Palm handhelds, onto which he loaded PiCoMap, a free software application available on the Internet from The Center for Highly Interactive Computing in Education (Hi-CE) at the University of Michigan (http://www.hi-ce.org). After a few days of instruction in the basics of using

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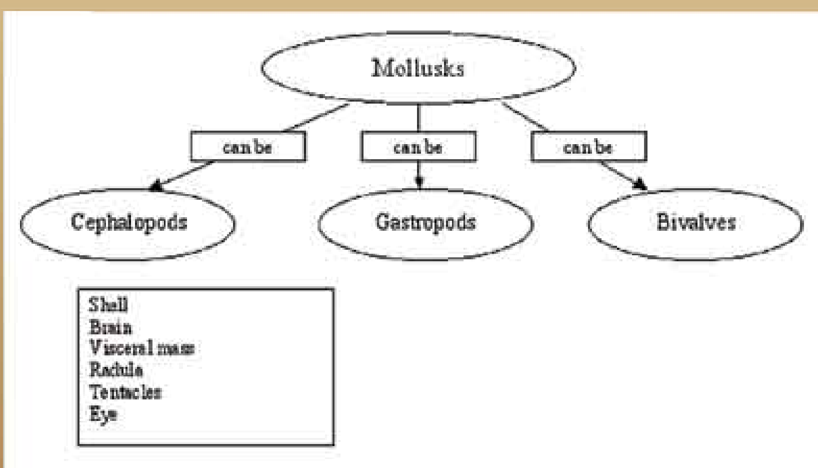
Designing Concept Mapping for Meaningful Learning

Concept mapping is often considered a generic term for any type of graphic organizer. However, there is a specific process that should be followed when creating a concept map.

To support meaningful learning, well-designed concept mapping activities should be hierarchical—that is, concepts should be related to subconcepts with directional links, and the relationships should be explained with propositions. Having assigned students to create concept maps with and without linking words that explain the relationships, co-author Jeff reports that the linking words are key to helping students understand relationships between the concepts.

Well-designed concept mapping activities should be open ended; no two students' maps should be alike, and there should be no "correct" answers. In the past, Jeff only modeled concept mapping, creating the beginnings of a map on the board for all students to copy. Now Jeff scaffolds students' creating their own maps by providing a list of some key concepts and the beginning of a map, as in the example below. By having students create their own concept maps, Jeff can determine how well students understand the concept instead of how well they memorize the teacher's map.

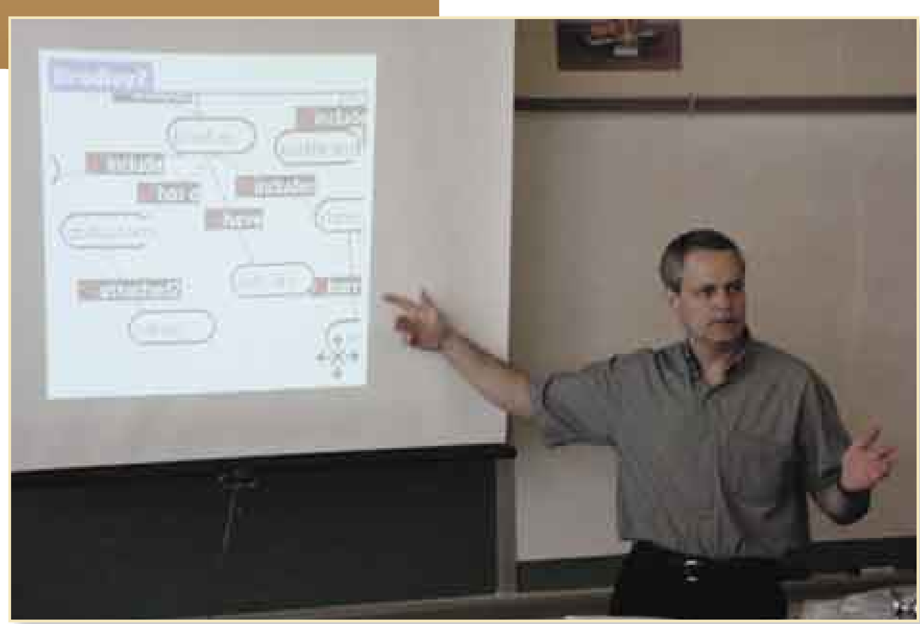
Finally, concept mapping activities should support revision. Students should share the meanings of their maps; this can be done in small groups or as a class discussion. Then students should revise their maps to correct prior misconceptions and to reflect new understandings as learning continues.



Jeff drew a simple map like this on the board and solicited keywords to show students how to create concept maps.

handhelds and PiCoMap, students in both of his classes were proficient enough to begin to create concept maps to demonstrate their understanding of science content.

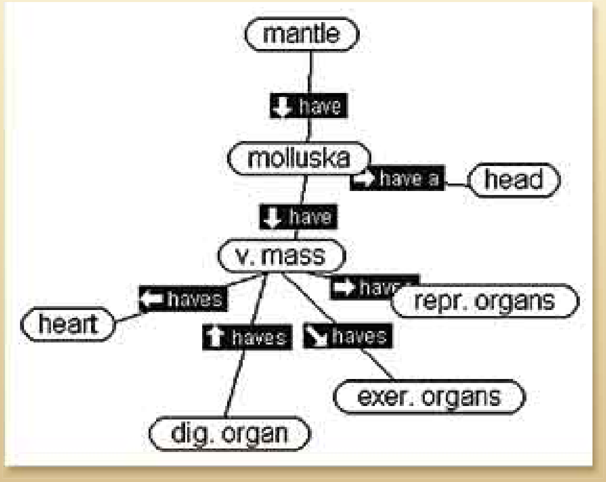
Instead of going to the computer lab, students were now able to remain in their classroom to create electronic concept maps. Because of easy access, concept mapping became a seamless part of instruction. Throughout the spring semester, students created concept maps to illustrate their understanding of worms, mollusks, and simple invertebrates. To help the students understand hierarchy, Jeff demonstrated creating concepts and subconcepts. He also asked students to practice creating concept maps from selected readings in their text. These assignments were always open ended. Jeff emphasized that there was no one right way to design a map. He displayed student maps on the LCD projector for class discussion. Finally, Jeff provided ample class time for revision and after additional instruction, he asked students to revisit their maps and revise them based on their new understanding.

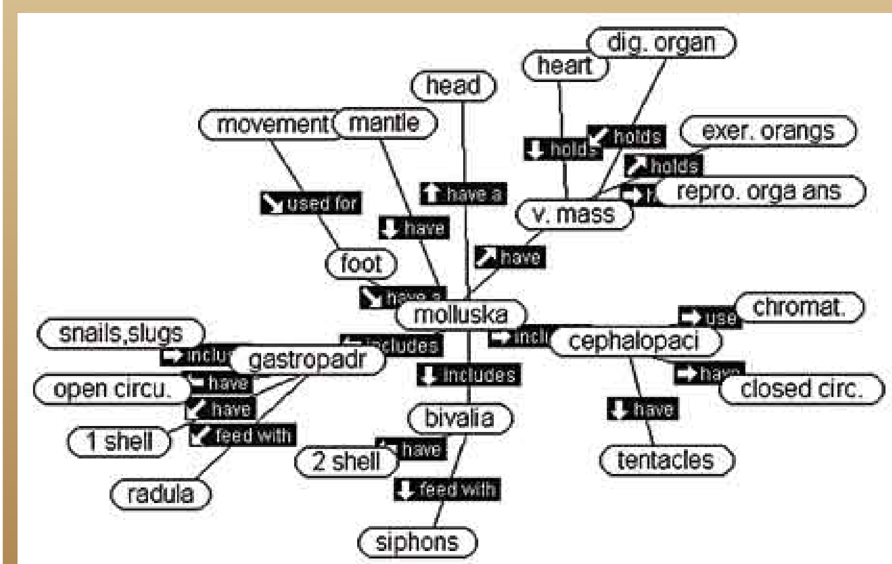


Student Reactions

Students were very positive in their reactions to using handheld computers. The majority of students in both classes preferred to use handheld computers rather than paper and pencil or desktop computers to create concept maps.

Compared to paper, they said it was easier to move things around on a handheld, it was faster and easier to get organized, and it was more fun. One student's response was typical: "It was more fun and neat as well as organized." Two students did, however, prefer paper. One student explained, "I am a creative person





These concept maps represent the complexity of student maps created before using handhelds (top) and after.

and my creative impulses allow me to see better through my brain on paper rather than the ‘perfectionist’ machine.”

The students who had experience using Inspiration on a desktop computer explained that they preferred the handheld to the desktop because it was quicker to access the program, quicker to create a map, it could be done in class rather than in the media center, the software was less complicated, the handheld automatically saved their files, and files were easier to submit (students beamed their files to the teacher). One student explained that he preferred the handhelds “because they’re easy, portable, and everybody can have their own.”

The majority of the students believed their concept maps were not only neater but also better when they created them with PiCoMap. Only 1 of the 41 students disagreed with the statement, “When my teacher asked me to make a concept map, I created a better map when I used PiCoMap than when I drew it on paper.” The students were asked to reflect on how the maps that they created using paper and pencil differed from the maps that they created using PiCoMap. Their responses clustered into several areas: neatness, detail, and organization. One student explained that the paper-and-pencil map was “messy, less detailed, and has doodles all over it.” Another student explained that the paper-and-pencil map was “not as complex.” In contrast, another student explained that the PiCoMap was “more elaborate and organized.” Another explained, “I get tired of writing really quick, so my concept map with the PiCoMap was longer.”

Teacher Reactions

Jeff expressed several reasons for using handheld computers to create concept maps. First, the students were more motivated to complete their work when using them. Few students put the time into it and stayed on task when using paper and pencil. With the handhelds, students not only completed their work, they also revised.

Second, Jeff believed that if the concept could be developed in less than 35 subconcepts, then the handheld computer was as effective a tool for concept mapping as the desktop computer. Jeff’s class discovered that the PiCoMap program would not generate more than 35 subconcepts for any one map. To work around that limitation, however, students discovered that they could make several individual files with PiCoMap, each focusing on a different branch of the concept map. To see if concept maps with handheld computers were as complex as those created with desktop computers when the concept was very large, Jeff assigned the students to make concept maps about simple invertebrates. Jeff assigned one class to use handheld computers and PiCoMap software and assigned a second class to use Inspiration and desktop

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computers. In this case, the concept maps were significantly different in their complexity. The mean score for the concept maps created with the handheld computers was 57.8, while the mean score for the concept maps created with the desktop computers was 80.1. Because concept maps with more subconcepts and links are given a higher score, these mean scores indicate that on average, the concept maps created with the desktop computers were more complex. This may have been because it was easier for the students to see relationships between ideas when the entire map was visible on the computer screen at once. With the handheld computers, students must scroll to see a larger area of the screen. Given this limitation of the program, Jeff recommends that teachers use PiCoMap when the students' concept maps are smaller. When students' maps expand as they begin to understand even more connections and cross-connections between concepts, then Inspiration would be a better tool to support student thinking.

Finally, the biggest advantage of using handhelds was classroom management. Instead of taking students to the media center lab to use desktop computers, Jeff could simply pass out the handhelds and continue with instruction. He explained that it was as seamless as if he were asking students to get out their calculators. Jeff also explained that teachers need to have flexibility to time a lesson. It is difficult to know exactly when the students will be ready for the concept mapping activity. Instead of blocking out a time to use the media center lab two weeks in advance, the teacher can decide when the timing is right to transition to the handheld activity. Jeff explained that when using a concept mapping strategy, some students would need more time to complete or revise their maps. With handhelds in the classroom, it is easy to manage students working on various activities simultaneously.

Because of their low cost, ease of use, and ability to manipulate and display data, handheld computers may be the wave of the future. From our experience, concept mapping is one of the better strategies for using these tools to support meaningful learning. With the exception of the very large concept map, concept maps created on handheld computers can be as complex as those created with desktop computers. For a variety of reasons, teachers and students are both motivated to use this learning tool. As one student in the class said, "it is a way that will revolutionize the way we learn."

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Jeff Royer teaches biology at James M. Bennett High School. A teacher for 25 years, he uses technology in all facets of his courses to help students understand the basic concepts of biology. He is an adjunct instructor for educational technology at Salisbury University. He has presented on the integration of multimedia into the classroom at conferences in Maryland, Colorado, Texas, and California.